MASS STABILISATION

MASS STABILISATION TECHNICS LABORATORY TESTS, QUALITY CONTROLLING

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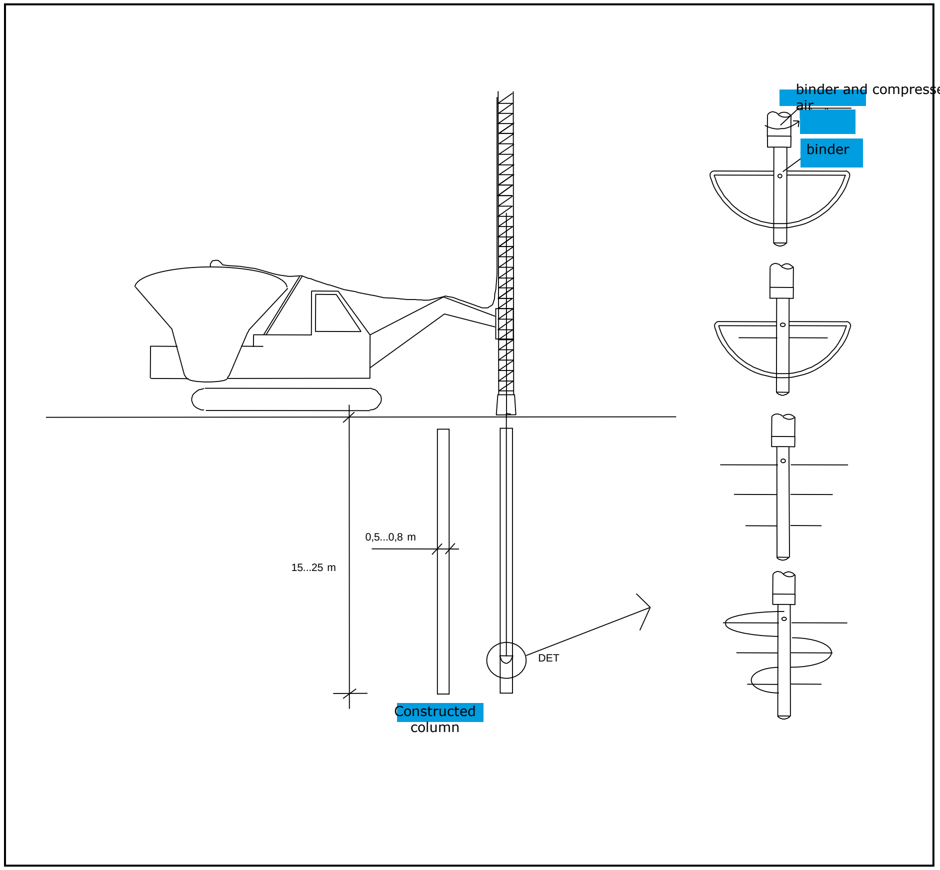
HISTORY OF NORDIC DEEP STABILISATION, COLUMN STABILISATION

- 1960's in Sweden and Japan
- Became more common in the 1970's – first site in Finland in 1974
- In the 1980's established as a normal ground improvement method
- Lime used at 1970's and 1980's
- Lime and cement mixture used from the end of 1980's



- z_{max} = 16…25 m
- d = 0.5…0.8 m

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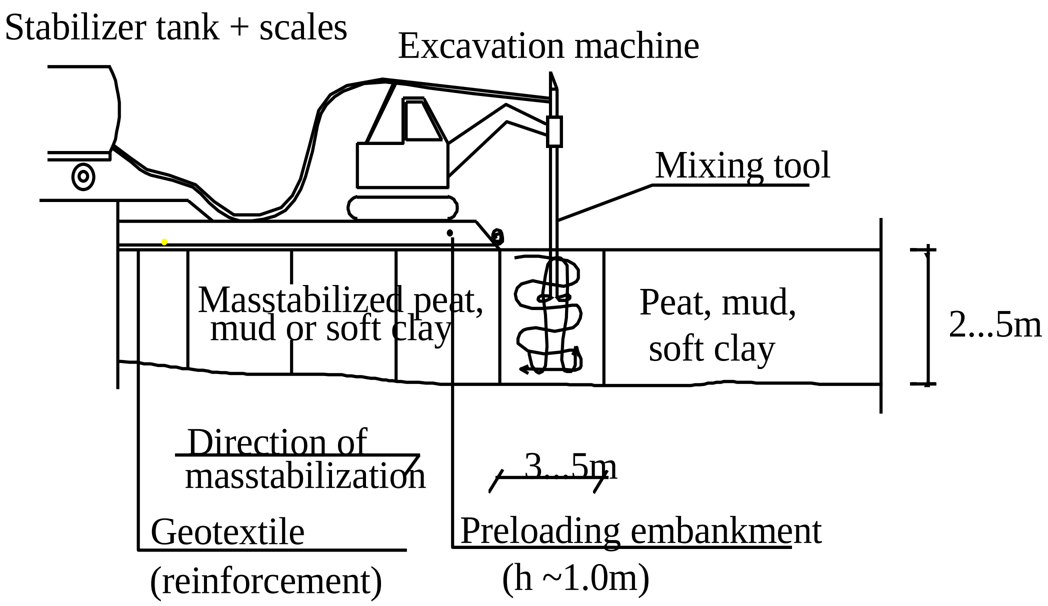
HISTORY OF NORDIC DEEP STABILISATION
MASS STABILISATION

- Mass stabilisation method developed in Finland in the early 1990's
- First mass stabilisation test site in 1993 (Vettoistensuo)
- First large-scale mass stabilisation site in 1995 (Råneå)
- New mass stabilisation equipment developed in late 1990's to early 2000 by Ideachip (now Allu)



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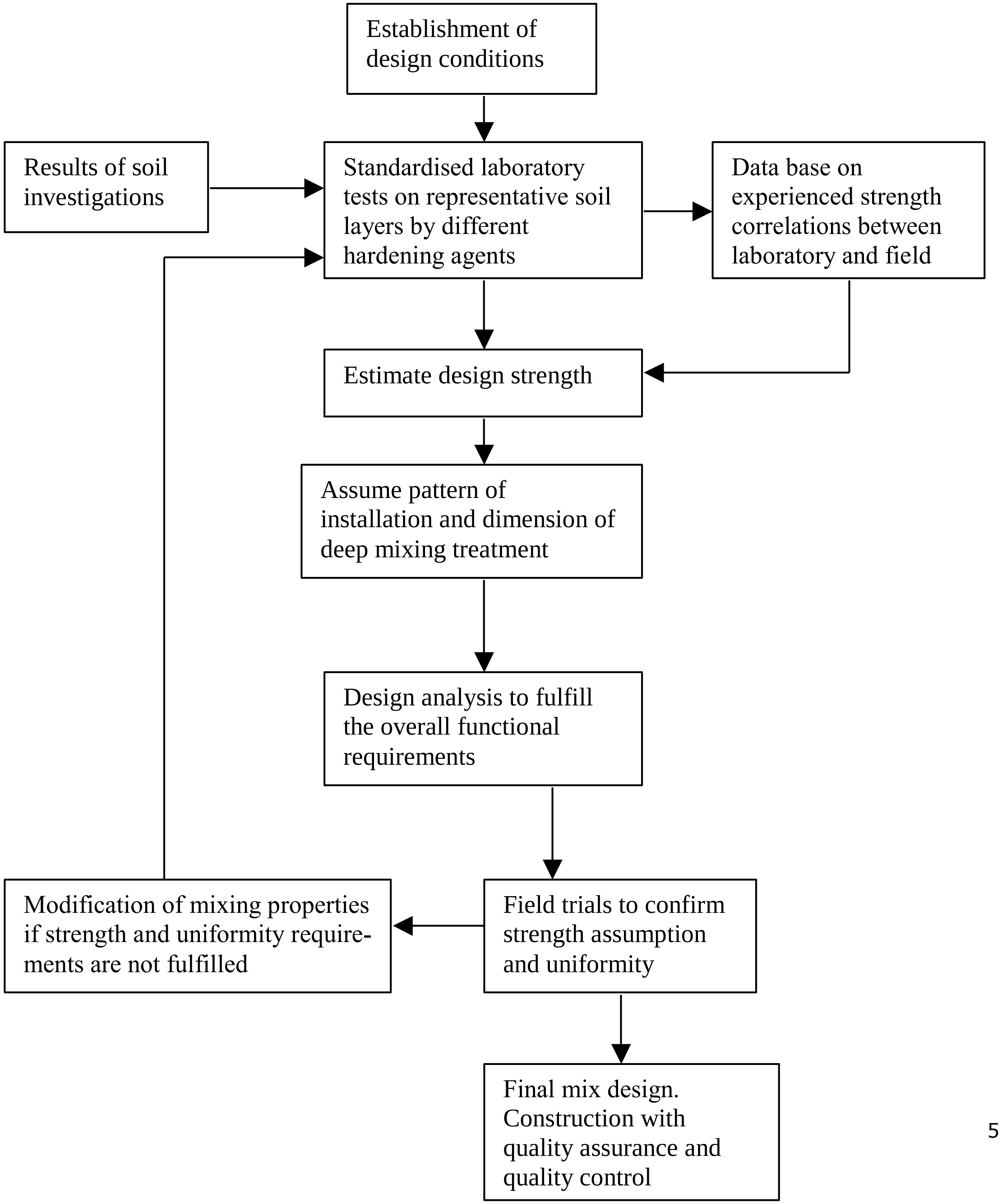
APPLICATIONS OF MASS STABILISATION

- Settlement reduction (embankments, structures, …)
- Improvement of stability
- Support of slopes and excavations
- Improvement of bearing capacity
- Immobilisation and/or confinement of waste deposits or polluted soils
- Reduction of vibrations

DIMENSIONING

Iterative design process, including:

- laboratory testing
- functional design
- field trials and
- process design



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DIMENSIONING

EuroSoilStab

Development of design and construction methods to stabilise soft organic soils

Design Guide Soft Soil Stabilisation

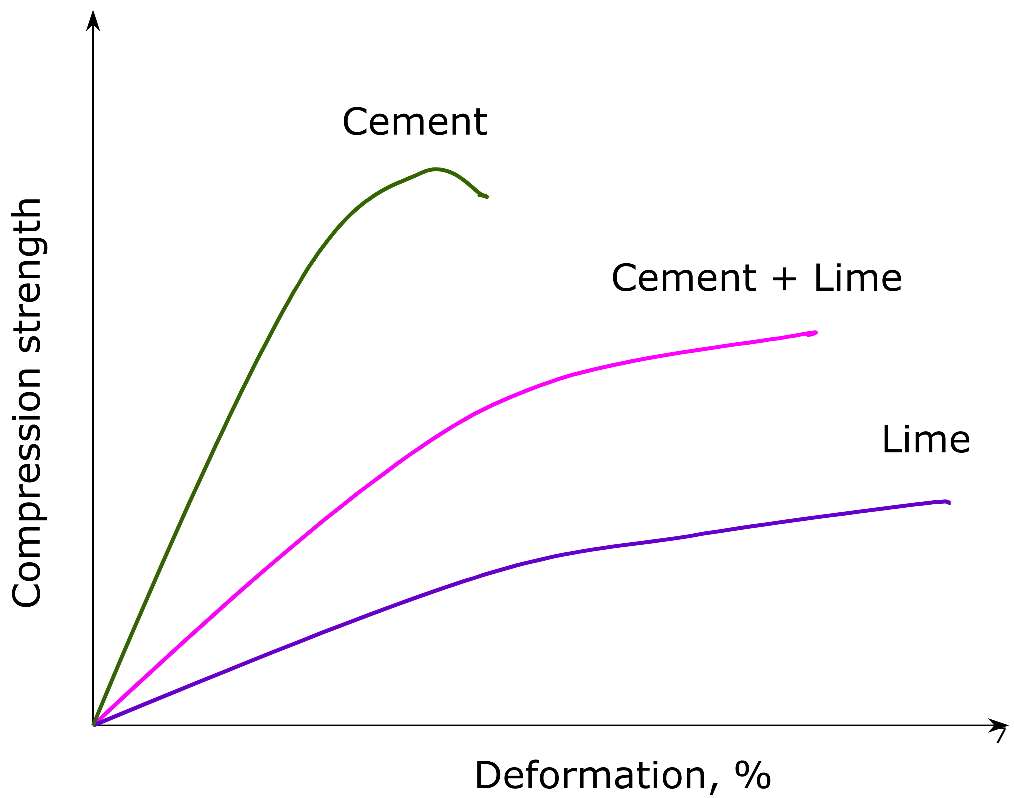
CT97-0351

Project No.: BE 96-3177

BINDERS

- Lime
- Lime + Cement
- Cement
- Fly-ash
- Gypsum
- Blast-furnace slag
- Mixture of several binders

SOIL	TYPICAL QUANTITY OF BINDER [kg/m³]
Clay	120-200
Peat	150-250
Dredged sediment	70-200



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SOIL SAMPLES FOR LABORATORY TESTS

- Sampling is based on site investigations.
- Reliable laboratory results are based on adequate amount of samples -> Rather too many than too few samples!
- Wrong conclusions may be done as a result of improper sampling. That may cause additional costs or lower quality than targeted.
- Samples are excavated (bulk samples) or they can be taken into sample tubes. Sampling disturbance is allowed.
- Samples should be stored and transferred in temperature over 0° C. The sample in container must be protected from air, water and light.
- It should be noticed during sampling and handling of samples if the area may be contaminated.

PLACES OF SAMPLING

- Usually one or two main sampling points are chosen
- The points will be chosen to find:

    - the most problematic layers for the tests

    - the most critical areas for designing parameters

    - high water content

    - high LOI (organic content)

    - some chemical properties (f.ex. sulphate)

-> if the recipe works with difficult materials, the results will be at least as good with easier materials

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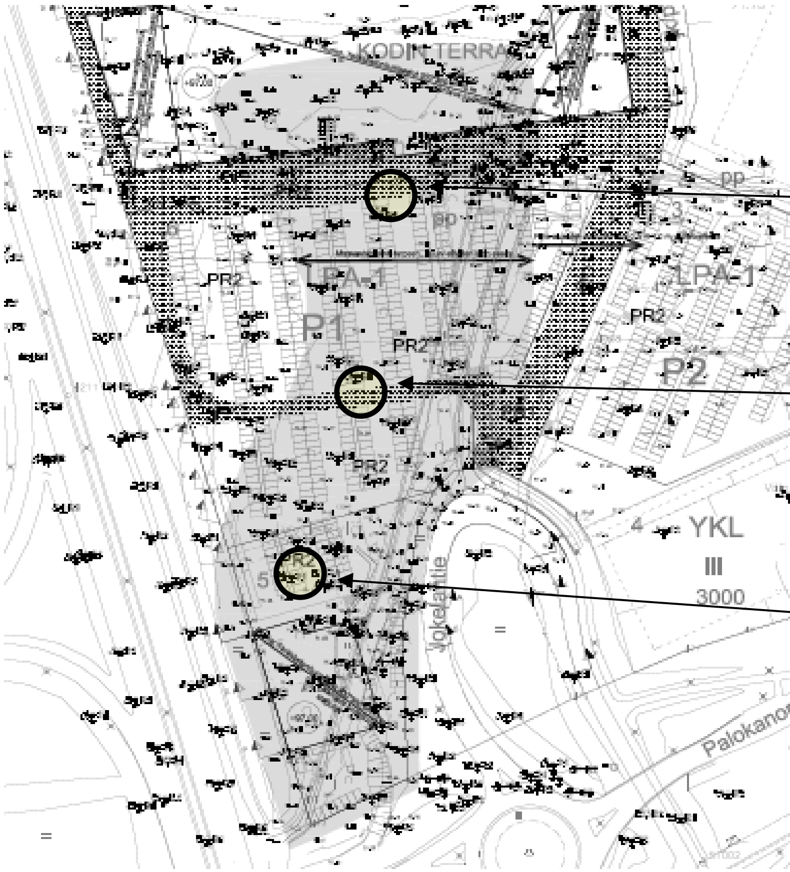
AN EXAMPLE OF SAMPLING FOR LABORATORY TESTS



Samples from line G-G:
- peat 15 litres, depth 1.5-2 m
- silt 10 litres, depth 4 m
- little samples a`0.5 litres
  1 sample / 1 m to the depth of 6 m

Samples from line J-J:
- peat 10 litres, depth 2 m
- little samples a`0.5 l

1 sample / 1 m to the depth of 6 m

Samples from line O-O:
- peat 25 litres, depth 1.5 m
- peat 25 litres, depth 3 m
- silt 10 litres, depth 4.5-5 m
- little samples a`0.5 litres

1 sample / 1 m to the depth of 6 m

CHOOSING OF SUITABLE BINDER AND OPTIMAL AMOUNT OF BINDER

Preliminary tests

It is often useful to make some specimens immediately and test their strength after 1-5 days. It gives a rough estimate of possible binders and amount of them. Also grain size, organic content etc. of samples should be tested.

First step

Tecnical tests (strength and water permeability etc.) and necessary environmental tests (leaching etc.):

- Suitable binder
- Strengthening during time (7, 14, 28, 90 days)
- Amount of binders

Second step

Optimising the amount of binder using technical, economical and environmental aspects. Also it could be useful to test parameters of stabilised material in real conditions using f.ex. loading.

MAKING TEST SPECIMENS OF CLAY, SILT, SEDIMENT ETC.


MAKING OF PEAT SPECIMENS AND KEEPING THEM UNDER LOAD

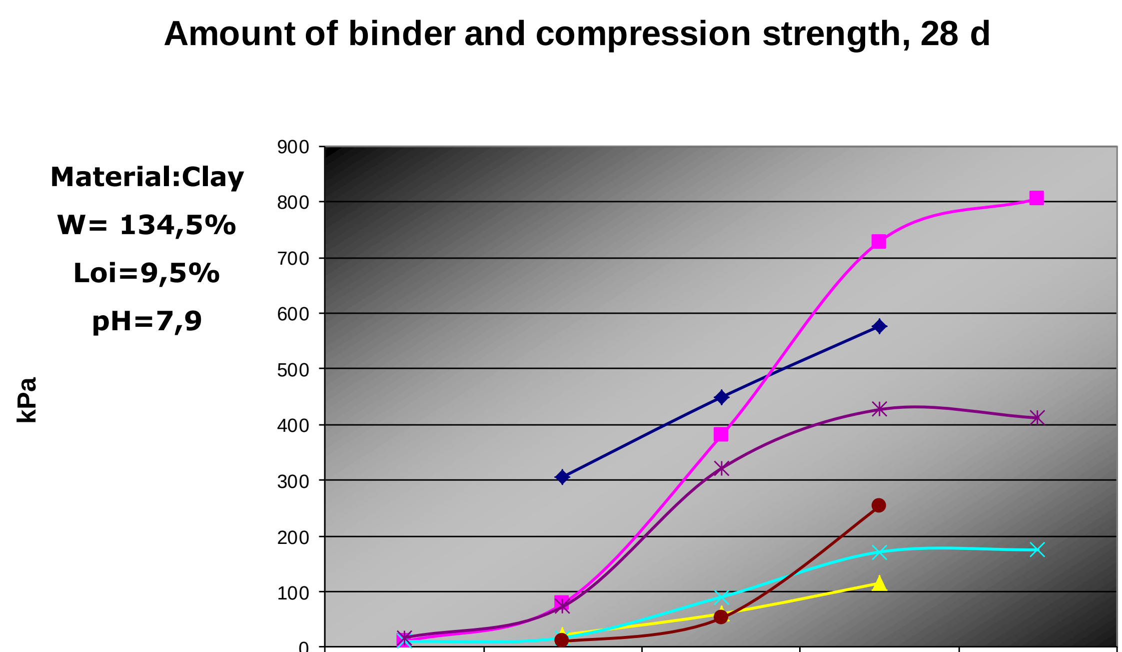
1- AND 3-AXIAL COMPRESSION STRENGTH TEST EQUIPMENT

WATER PERMEABILITY TEST (FLEXIBLE WALL)

EXAMPLES OF NEW BINDER ADMIXTURES AND COMPONENTS

- Cement
- Cement + CaO
- Cement + blast furnace slag (BFS)
- Gypsum
- Ashes, Fly Ash (FA)

etc.



	40 kg/m3	60 kg/m3	100 kg/m3	140 kg/m3	200 kg/m3
Cement		306	449	577	
Cement+slag 1:1	10	78	380	729	806
Cement+CaO 1:1		22	60	115	
Gypsum +lime	10	17	90	171	175
Gypsum+lime+cement	17	73	321	427	412
Gypsum mixture		10	52	253	

QUALITY CONTROLLING OF MASS STABILISATION

IN SITU TESTS:

- Column penetration soundings
- Vane auger tests (lightweight)
- (CPT- tests)
- Sampling for lab tests
- Settlement survey
- Documentation of used binder and their amounts and made blocks their volume.

BINDER CONTENT:

- Binder content test in laboratory comparison of Ca-content (basic soil samples, binder samples and stabilised samples)
- Binder content test by measuring Ca-content by Niton (X-ray fluoresence)

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MASS STABILISATION – RAMBOLL'S SERVICES

- Binder technology
- Industrial by products
- Laboratory testing
- Geotechnical design
- Working documents
- Quality control
- Supervision

THANK YOU!